



Canyon Fuel
Company, LLC.
Sufco Mine

A Subsidiary of Arch Western Bituminous Group, LLC.

COPY

Ken May, General Manager
597 South SR 24
Salina, UT 84654
(435) 286-4400 - Office
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#3548

Q

June 4, 2010

File in:

☐ Confidential

☐ Shelf

☒ Expandable

Date Folder 060710 C/0410002

See: Incoming

Mr. Daron Haddock
Permit Supervisor
Utah Coal Regulatory Program
Utah Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
P. O. Box 145801
Salt Lake City, Utah 84114-5801

RECEIVED

JUN 07 2010

DIV. OF OIL, GAS & MINING

RE: New Portals Amendment to the Canyon Fuel Company, LLC, Sufco Mine, Permit Number C/041/0002

Dear Mr. Haddock:

Please find enclosed with this letter the Sufco Mine permit amendment to include three new portals in the mine's M&RP. We have included five copies of the modified text in redline/strikethrough format, plates 5-2A, 5-2B, and 7-6, and completed C1 and C2 forms. Clean copies of the pages with modifications will be forwarded to the Division once the modification is approved for inclusion in the permit.

Sufco mine is planning the construction of three new portals within the current disturbed area boundary at the mine site. The locations of the portals are just north of the warehouse. All three portals are being constructed on the cut slope made during construction of the mine yard. No new vegetation will be disturbed and no topsoil exists in the area of construction. Construction would include the removal of a pulley storage rack, moving the ditches that drain undisturbed watersheds MSH-2, MSH-2A, and ESC 7 to above the new portals, removal of the 6" pipe that drains ESC-7 and increasing the diameter of the steel pipe that drains ESC 6.

The ditch that drains undisturbed watersheds MSH-2 and MSH-2A would be moved above the new portals. Current ditch dimensions would be kept to insure adequate volume for flows. The 6" steel pipe that drains MSH-2A would be extended to the new ditch outlet. This pipe connects to the 72" bypass culvert. MSH-2 would continue to report to the inlet of the 42" Mud Spring Hollow bypass culvert via a ditch that would be extended to the outlet.

The undisturbed ditch that drains ESC-7 would be reconstructed so that flows would report to an 8" pipe on the north east end of this ditch. Ditch dimensions would be kept to specifications currently stated in Appendix 7-12 of the MRP. The 8" pipe would report to 72" bypass culvert via the 10" pipe that drains undisturbed watershed ESC-6.

The 6" pipe that currently directs water from undisturbed ESC-6 to the 72" bypass culvert will be replaced with a 10" pipe. This is to handle the flows of both ESC-6 and ESC-7. The 8" pipe that drains ESC-7 will be teed into this 10" pipe.

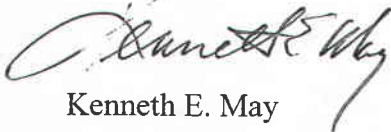
COPY

Certified stamped copies of drainage pipe calculations are included and will be added to Appendix 7-13 of the MRP.

Removal of plate 7-7, Mine Yard Watershed Boundaries, from the MRP. Plate 7-7 showed watershed boundaries from the primary sedimentation pond to the top of mine yard, with the construction of the overflow sedimentation pond this plate has been combined with plate 7-6 to show drainage details and watershed boundaries for the entire mine site facilities in East Spring Canyon.

Sufco mine needs approval of this amendment to start construction by July 1st of 2010. If you have any questions regarding the information contained in this letter or within the permit modification, please call Leland Roberts at (435) 286-4483.

Sincerely,
CANYON FUEL COMPANY, LLC
Sufco Mine



Kenneth E. May
General Manager

Encl.

cc: DOGM - Price Field Office
DOGM Correspondence File

KEM/FLR:kb

APPLICATION FOR COAL PERMIT PROCESSING

COPYPermit Change ☒ New Permit ☐ Renewal ☐ Exploration ☐ Bond Release ☐ Transfer ☐Permittee: CANYON FUEL COMPANY, LLCMine: SUFCO MINEPermit Number: C/041/002Title: New portals at main mine facilities in East Spring Canyon

Description, Include reason for application and timing required to implement:

Three new portals at the mine site facilities in East Spring Canyon. Construction to begin July of 2010**Instructions:** If you answer yes to any of the first eight (gray) questions, this application may require Public Notice publication.

- ☐ Yes ☒ No 1. Change in the size of the Permit Area? Acres: _____ Disturbed Area: _____ ☐ increase ☐ decrease.
☐ Yes ☒ No 2. Is the application submitted as a result of a Division Order? DO# _____
☐ Yes ☒ No 3. Does the application include operations outside a previously identified Cumulative Hydrologic Impact Area?
☐ Yes ☒ No 4. Does the application include operations in hydrologic basins other than as currently approved?
☐ Yes ☒ No 5. Does the application result from cancellation, reduction or increase of insurance or reclamation bond?
☐ Yes ☒ No 6. Does the application require or include public notice publication?
☐ Yes ☒ No 7. Does the application require or include ownership, control, right-of-entry, or compliance information?
☐ Yes ☒ No 8. Is proposed activity within 100 feet of a public road or cemetery or 300 feet of an occupied dwelling?
☐ Yes ☒ No 9. Is the application submitted as a result of a Violation? NOV # _____
☐ Yes ☒ No 10. Is the application submitted as a result of other laws or regulations or policies?
 Explain: _____
☐ Yes ☒ No 11. Does the application affect the surface landowner or change the post mining land use?
☐ Yes ☒ No 12. Does the application require or include underground design or mine sequence and timing? (Modification of R2P2)
☐ Yes ☒ No 13. Does the application require or include collection and reporting of any baseline information?
☐ Yes ☒ No 14. Could the application have any effect on wildlife or vegetation outside the current disturbed area?
☒ Yes ☐ No 15. Does the application require or include soil removal, storage or placement?
☐ Yes ☒ No 16. Does the application require or include vegetation monitoring, removal or revegetation activities?
☒ Yes ☐ No 17. Does the application require or include construction, modification, or removal of surface facilities?
☒ Yes ☐ No 18. Does the application require or include water monitoring, sediment or drainage control measures?
☒ Yes ☐ No 19. Does the application require or include certified designs, maps or calculation?
☐ Yes ☒ No 20. Does the application require or include subsidence control or monitoring?
☒ Yes ☐ No 21. Have reclamation costs for bonding been provided?
☐ Yes ☒ No 22. Does the application involve a perennial stream, a stream buffer zone or discharges to a stream?
☐ Yes ☒ No 23. Does the application affect permits issued by other agencies or permits issued to other entities?

Please attach four (4) review copies of the application. If the mine is on or adjacent to Forest Service land please submit five (5) copies, thank you. (These numbers include a copy for the Price Field Office)

I hereby certify that I am a responsible official of the applicant and that the information contained in this application is true and correct to the best of my information and belief in all respects with the laws of Utah in reference to commitments, undertakings, and obligations, herein.

KENNETH E. MAY, MINE MANAGER

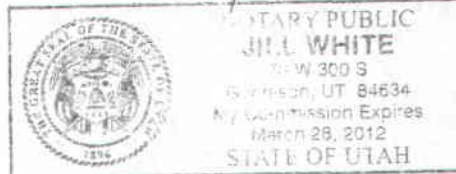
Print Name

Sign Name, Position, Date

Subscribed and sworn to before me this 4th day of June, 2010

Notary Public

My commission Expires: _____, 20____

Attest: State of _____ } ss:
County of _____ }

For Office Use Only:

Assigned Tracking
Number:

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JUN 07 2010**DIV. OF OIL, GAS & MINING**

COPY

Permit Number: C/041/002

Provide a detailed listing of all changes to the Mining and Reclamation Plan, which is required as a result of this proposed permit application. Individually list all maps and drawings that are added, replaced, or removed from the plan. Include changes to the table of contents, section of the plan, or other information as needed to specifically locate, identify and revise the existing Mining and Reclamation Plan. Include page, section and drawing number as part of the description.

[illegible]

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is only temporarily stored at the mine prior to off-site disposal, there is no significant potential for this debris to spontaneously combust. Fire extinguishers are kept on mobile equipment in the mine yard to extinguish any fires should combustion of the waste materials occur. Waste materials that constitute a fire hazard (e.g., grease, lubricants, paints, and flammable liquids) will be stored in such a manner as to minimize any fire hazard. Empty containers of such products will only be stored temporarily at the mine-site prior to proper off site disposal.

5.2.8.4 Dams, Embankments, and Impoundments

No dams, embankments, or impoundments are used for the handling or disposal of coal, overburden, excess spoil, or coal mine waste in the permit area.

5.2.9 Management of Mine Openings

~~Ten~~ **Thirteen** underground mine openings exist within the permit area. Locations of these portals are shown on Plates 5-2A,C,&F. ~~Three~~ **Six** of these openings are located at the mine surface facilities in East Spring Canyon and serve as primary pathways for ingress and egress of personnel and machinery, removal of coal from the mine, and mine ventilation. The remaining seven openings are located as follows:

- 3 East portals - 2 intakes

- Quitcupah portals - 2 intakes

- 4 East portals - 1 intake and 1 fan portal

- Link Canyon Portal - 1 intake

These remaining (non-East Spring Canyon) openings are used for mine ventilation and emergency egress. Each of these supplementary intakes is protected from unauthorized entry by the installation of steel sets and a locked chain-link gate. The keys for the gates are kept approximately 25 feet from the gates inside the mine. This permits emergency exit from the mine but prevents entrance from the outside.

Each underground mine opening is protected from deterioration through the installation of **steel portal liner**, steel sets, and timbers. These protective measures are inspected weekly to ensure that they remain in good condition.

Any portals which become temporarily inactive in the permit area, but have a further projected useful service, will be protected through the installation of a lockable chain-link gate as described above to prevent unauthorized entry. Warning signs will be posted to identify the hazardous nature of the opening. These protection and warning devices will be periodically inspected and maintained in good operating condition during the period of temporary inactivity.

- East Spring Canyon bypass culvert emergency diversion at the main mine fan. This 3.5 foot square drop drain with oil skimmer cap connects into a 48-inch culvert directed into the East Spring Canyon bypass culvert. This serves as an overflow system when the trash rack at the inlet to East Spring Canyon becomes plugged with debris.
- 6 8-inch pipe diversion for undisturbed watershed ESC-7. This pipe discharges ~~tees to the East Spring Canyon bypass culvert~~ 10-inch pipe that drains undisturbed watershed ESC-6.
- Main Mine Fan Diversion. The main mine fan is located in a depression which is nine feet below the adjacent mine yard drainage system. A sump pump with automatic float controls in front of the main fan will pump the runoff from this area into the 10-inch mine yard drain line.
- 10-inch mine yard culvert drainage system. This system discharges to the concrete sediment trap.
- Link Canyon Portal bypass culvert which drains watersheds LCP-East and LCP-West.
- The primary sediment pond diversion culvert allows runoff from the disturbed area to bypass the primary sedimentation pond, thereby allowing water to be drained from the primary sedimentation pond for sediment removal. This culvert discharges to the overflow pond.
- The 66-inch overflow pond bypass culvert allows runoff from undisturbed watersheds DWN-1, DWN-2, DWN-3, MSH-1, MSH-2, and ESC-1 through ESC-7 to bypass the overflow pond. This culvert discharges immediately downstream of the overflow pond.

All diversion ditches are maintained with adequate rip-rap or alternative erosion protection in the ditch sections where flow velocities are great enough that a ditch lining is necessary. Adequate ditch capacities are maintained in all ditch sections. Culverts are kept free of debris and each outlet is lined with adequate riprap. Detailed diversion design is presented in Section 7.4.2.

Water bars in roadside ditches have been constructed of rocks to form low dams across the ditches. The rocks are large enough to resist movement during anticipated run-off events. They are arranged to channel water down the center of the ditch rather than around the water bar ends to prevent erosion of the ditch side walls. Accumulations of sediment behind the ditch water bars are permitted to rise to the lowest height of the bar.

Diversion ditch and culvert operation and maintenance for the diversions within the waste rock disposal site are presented in Volume 3 of this M&RP.

The primary sedimentation pond diversion culvert allows discharge from the sedimentation trap to bypass the primary sedimentation pond and flow directly into the overflow pond. This culvert is also designed to allow discharge from the primary sedimentation pond to flow directly into the overflow pond. Due to this culvert acting as a bypass for the primary sedimentation pond the 18-inch CMP sedimentation trap diversion has been designed to convey the 25-year, 6-hour precipitation event. For more information see Plates 7-4 and 7-5A and Appendix 7-23.

Diversion of Miscellaneous Flows. Diversion ditches and culverts have been utilized within the permit area to divert miscellaneous flows from disturbed and undisturbed area drainages.

Diversion Ditches. A summary table of the minimum channel geometry, channel slope, peak discharge, minimum riprap requirements, maximum flow velocity and minimum freeboard values for each diversion ditch within the facilities area is presented in Table 7-9. All calculations are contained in Appendix 7-12 and 7-23. Each ditch was verified in the field and has adequate capacity and erosion protection to pass the 10-year, 6-hour precipitation event. A description of the diversion ditches within the facilities area is presented below:

- Interception ditch along the East Side Road which drains the undisturbed watershed CBE-5. This diversion drains into the CBE bypass culvert at the substation.
- Interception ditch along the East Side Road which drains the undisturbed watersheds CBE-1 through CBE-5. This diversion drains into the CBE continuance diversion.
- Substation pad upper interception ditch which drains the undisturbed watershed CBE-4. This diversion drains into the CBE bypass culvert at the substation.
- Substation pad lower undisturbed interception ditch which drains the watershed CBE-3. This diversion drains into a drop drain for the CBE bypass culvert at the substation and is part of the alternate sediment control measures defined in Section 7.4.2.1.
- Riprap diversion channel for CBE continuance diversion. This diversion carries flows from the lower interception ditch along the East Side Road to an adjacent ephemeral drainage.
- Interception ditch for the undisturbed watershed ESC-6 north of the ATOF. This diversion discharges to the inlet of the ~~6-inch~~ 10-inch pipe diversion which connects into the 72-inch East Spring Canyon bypass system.
- Interception ditch for the undisturbed watershed ESC-7 north of the ATOF. This diversion drains to the ~~6-inch pipe diversion which connects into the 72-inch East~~

~~Spring Canyon bypass system~~ an 8-inch pipe that tees into the 10-inch pipe which drains ESC-6.

- Interception ditch for the undisturbed watershed MSH-2 north of the ATOF. This diversion drains to the inlet of the 42-inch Mud Spring Hollow bypass.
- Interception ditch for the undisturbed watershed MSH-2A north of the ATOF. This diversion drains to the 6-inch pipe diversion which connects into the 72-inch East Spring Canyon bypass system.
- Interception ditch draining watershed DIS-1A. This diversion drains to one of the drop drain inlets of the 10-inch mine yard drain line.
- Sedimentation pond access road diversion ditch. This diversion drains the disturbed watershed DIS-3 and discharges to the sedimentation pond.
- Main access road diversion ditch which drains undisturbed watershed DWN-1. This ditch drains to the pipe number 5 diversion.
- Link Canyon Substation No. 1 ditch which drains the watersheds LINK and ASCA-1. This diversion diverts the upper undisturbed drainage around the substation and drains to the Link Canyon Substation No. 1 road swale. This diversion ditch was reclaimed in 2000.
- Link Canyon Substation No. 1 road swale which drains watersheds LINK, ASCA-1, and ASCA-3. This diversion carries flows from the Link Canyon Substation No. 1 ditch across the substation access road to the main Link Canyon road drainage. This diversion was reclaimed in 2000.
- Link Canyon Substation No. 2 ditch which drains the watersheds LINK No.2, ASCA-4 and ASCA-7. This diversion diverts the upper undisturbed drainage around the substation and drains to the main Link Canyon road drainage.
- Link Canyon Portal access road Channel No. 1 diversion ditch. This diversion diverts the access road disturbed drainage and the undisturbed drainage above the road to the Link Canyon drainage bypass culvert inlet.
- Link Canyon Portal Pad Channel No. 2 diversion ditch. This diversion diverts the pad area disturbed drainage and the undisturbed drainage above the pad to the Link Canyon drainage bypass culvert inlet.
- The west overflow pond undisturbed area diversion channel. This channel diverts runoff from the undisturbed area immediately west of the overflow pond and conveys the runoff south to the overflow pond access road channel.
- The overflow pond access road channel. This channel diverts runoff from the undisturbed area immediately west of the overflow pond access road and runoff from the west overflow pond channel south along the west side of this road to a swale and across U.S.F.S road.

- 6 10-inch pipe diversion for undisturbed watersheds ~~ESC-7, ESC-6, and MSH-2A~~ ESC-6 and ESC-7. This pipe connects into the 72-inch East Spring Canyon bypass system.
- 8-inch pipe diversion for undisturbed watershed ESC-7. This pipe connects to the 10-inch pipe that drains undisturbed watershed ESC-6.
- 6-inch pipe diversion for undisturbed watershed MSH-2A. This pipe connects into the 72-inch East Spring Canyon bypass system.
- Link Canyon Portal bypass culvert. This culvert drains the undisturbed watersheds LCP-East and LCP-West and discharges back into the Link Canyon drainage.
- Main Mine Fan Diversion. The main mine fan is located in a depression which is nine feet below the adjacent mine yard drainage system. A sump pump with automatic float controls in front of the main fan will pump the runoff from this area into the 10-inch mine yard drain line.
- 10-inch mine yard drainage system. This drainage system was installed to handle normal surface flows in the mine yard and to reduce the occurrence of mud and erosion. The drainage system consists of drop inlets and a 10-inch pipeline discharging to the concrete sediment trap. It was not designed to pass the 10-year, 6-hour precipitation event. Instead, the surface area of the mine yard is graded to divert all runoff to the concrete sediment trap.
- The sediment trap diversion culvert allows the sedimentation pond to drain for sediment removal. This culvert discharges to the overflow pond.
- The 66-inch overflow pond bypass culvert allows watersheds DWN-1, DWN-2, DWN-3, MSH-1, MSH-2, and ESC-1 through ESC-7 to bypass the overflow pond. This culvert discharges immediately downstream of the overflow pond.

TABLE 7-10

Summary of Diversion Culverts

Diversion Culvert	Diameter (in.)	Material	Inlet type	Min. Slope (%)	Outlet Slope (%)	Existing riprap D ₅₀ (in.)	Peak Flow ^(a) (cfs)	Culvert inlet OK?	Existing riprap D ₅₀ OK?
East Spring Canyon bypass culvert at inlet	72	CMP	mitered	1.2	N/A	N/A	59.6	yes	N/A
Bypass culvert for combined East Spring Canyon and Mud Spring Hollow flows	Upper 72	CMP	N/A	Upper 1.2	Upper N/A	Upper N/A	97.7	Upper N/A	Upper N/A
	Lower 48			Lower 10.0	Lower 10.0	Lower 15.0		Lower N/A	Lower yes
Mud Spring Hollow bypass - discharges to East Spring Canyon bypass	42	CMP	mitered	1.8	N/A	N/A	38.1	yes	N/A
East Spring Canyon bypass culvert emergency diversion at main mine fan	48	CMP	drop		N/A	N/A	59.6		N/A
CBE bypass at substation	18	CMP	mitered and drop	1.0	10.0	6.0	0.53	yes	yes
Pipe No. 5 diversion draining DWN-1	18	CMP	mitered	10.0	28.0	12.0	0.85	yes	yes
8-inch pipe diversion draining ESC-7, discharges to 10 inch pipe draining ESC-6	8	steel	mitered	1.0	N/A	N/A	2.4	yes	N/A
10-inch pipe diversion draining ESC-6 and ESC-7, discharges to East Spring Canyon bypass	10	steel	mitered	1.0	N/A	N/A	3.19	yes	N/A
6-inch pipe diversion draining ESG-6, and MSH-2A, discharges to East Spring Canyon bypass	6	steel	mitered	1.0	N/A	N/A	0.24	yes	N/A
Link Canyon Portal bypass culverts	2-36	CMP	mitered	9.09	18.2	6.0	55.32 ^(b)	yes	yes
Main mine fan diversion				Not applicable since the mine yard drainage system is not designed to handle peak flows, only daily drainage volumes.					
10-inch mine yard drainage, discharges to sediment trap	10	Steel	drop						
Sediment Trap Diversion Culvert	18	CMP	mitered	1.2	1.25	N/A	6.26 ^(b)	yes	yes
Overflow Pond Bypass Culvert	66	CMP	mitered	2.8	3.0	12.0	622.37 ^(c)	yes	yes

Bonding Calculations

Direct Costs

Subtotal Demolition and Removal	\$1,052,959.00
Subtotal Backfilling and Grading	\$548,005.00
Subtotal Revegetation	\$171,967.00
Direct Costs	\$1,772,931.00

Indirect Costs

Mob/Demob	\$177,293.00	10.0%
Contingency	\$88,647.00	5.0%
Engineering Redesign	\$44,323.00	2.5%
Main Office Expense	\$120,559.00	6.8%
Project Mainagement Fee	\$44,323.00	2.5%
Subtotal Indirect Costs	\$475,145.00	26.8%

Total Cost	\$2,248,076.00
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Escalation factor	0.0444
Number of years	4
Escalation	\$426,645.00

Reclamation Cost Escalated	\$2,674,721.00
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Bond Amount (rounded to nearest \$1,000) 2009 Dollars	\$2,675,000.00
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Posted Bond	\$4,439,000.00
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Difference Between Cost Estimate and Bond	\$1,764,000.00
Percent Difference	39.74%

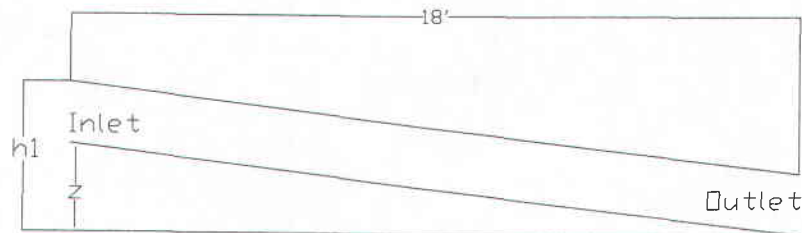
Ref.	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Ambulance Garage																			\$2,504.00
	Belt Deicer Tank																			\$13.00
	Blast Channels A																			\$143,211.00
	Blast Channels B																			\$53,488.00
	Bulk and Used Oil Storage																			\$1,518.00
	Cap Magazine																			\$22.00
	Chlorinator Bld																			\$18.00
	Covered Storage																			\$17,169.00
	Diesel Tank																			\$995.00
	Drainage Culverts																			\$15,944.00
	Electrical Bld																			\$602.00
	Fan																			\$7,781.00
	Fire Water Tank 300000 Gal																			\$11,126.00
	Fuel Dock																			\$928.00
	Guard House																			\$349.00
	Loadout Belt																			\$2,593.00
	Lower Stacker Coal Storage																			\$2,149.00
	Lump Coal Storage																			\$711.00
	No 1 Belt																			\$67,377.00
	Office Building																			\$29,153.00
	Pavement Removal																			\$22.00
	Power Magazine																			\$972.00
	Pulley Racks																			\$3,040.00
	Pump Houses																			\$259,568.00
	Riprap Filter Fabric																			\$3,357.00
	Rock Dust Bin																			\$1,022.00
	ROM Coal Storage																			\$21,139.00
	ROM MCC Bld																			\$991.00
	Sampler Building																			\$1,516.00
	Sand and Salt Storage																			\$62,400.00
	Seal Portals																			\$1,533.00
	Sediment Trap																			\$0.00
	Sediment Tanks																			\$60,022.00
	Shed																			\$11,941.00
	Shed and Warehouse																			\$2,322.00
	Shop Garage																			\$3,763.00
	Shop Office																			\$181.00
	Slide Release Tank																			\$7,713.00
	Steam Cleaner Building																			\$6,826.00
	Stoker Belt																			\$1,164.00
	Stoker Bin																			\$6,165.00
	Stoker Coal Storage																			\$1,539.00
	Stoker Oil Tanks																			\$1,756.00
	Storage Trailers																			\$72,827.00
	Substation Lower*																			\$0.00
	Substation Upper*																			\$69.00
	Ticket Printers																			\$36,194.00
	Tipple Building																			\$3,161.00
	Tipple MCC Building																			\$2,769.00
	Tipple Office Building																			\$10,101.00
	Transfer Building																			\$542.00
	Trash Pit																			\$1,895.00
	Truck Loader Bin																			\$36,352.00
	Truck Scale																			\$0.00
	Water Tank Upper																			\$8,042.00
	Water Tank Lower																			\$39,150.00
	Link Canyon Facilities																			\$2,597.00
	Link Canyon Portals																			\$18,066.00
	Link Canyon Substation																			
	Fourth East Facilities																			
	Fan Generator Building																			
	Four East Fan																			
	Total																			\$1,068,559.00

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Seal Portals																			
	Structure's Demolition Cost																			
	Structure's Vol. Demolished																			
	Rubble's Weight (exclude steel)																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Non Steel Truck																			
	Transportation Cost Non Steel Drive																			
	Disposal Cost Non Steel																			
	Steel's Weight																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Steel Truck																			
	Transportation Cost Steel Truck Drive																			
	Disposal Cost Steel																			
	Subtotal																			
	Seal Portals																			
	Main Mine Area	Seal Portals	AML1	5200 EA.	5200 EA.											6 EA			6 EA	31200
	Outcrops Portals	Seal Portals	AML1	5200 EA.	5200 EA.											2 EA			2 EA	10400
	Three East Portals	Seal Portals	AML1	5200 EA.	5200 EA.											2 EA			2 EA	10400
	South Portals	Seal Portals	AML1	5200 EA.	5200 EA.											2 EA			2 EA	10400
	Transport Costs																			
	Disposal Costs																			
	Subtotal																			62400
	Concrete Demolition																			
	Demolition Cost																			
	Concrete's Vol. Demolished																			
	Loading Cost																			
	Transportation Cost																			
	Disposal Costs																			
	Subtotal																			
	Concrete Demolition																			
	Demolition Cost																			
	Concrete's Vol. Demolished																			
	Loading Cost																			
	Transportation Cost																			
	Disposal Costs																			
	Subtotal																			
	Concrete Demolition																			
	Demolition Cost																			
	Concrete's Vol. Demolished																			
	Loading Cost																			
	Transportation Cost																			
	Disposal Costs																			
	Subtotal																			
	Total																			62400

ESC - 6 Sufco Mine Drainage Culvert

Reference: Lindeburg, Michael PE; Civil Engineering Reference Manual 8th Edition

Pipe ID
 $D := 6.25 \cdot \text{in}$
 $h1 := 30.09 \cdot \text{in}$ $h4 := 5 \cdot \text{in}$
 $z := 11.84 \cdot \text{in}$



Assume water column one foot above the inlet

$$\frac{h1 - z}{D} = 2.92$$

$2.92 > 1.5$

$$\frac{h4}{D} = 0.8$$

$0.8 < 1.0$

Type 5 Flow (p19-27)

$$Cd := 0.95 \quad Ao := \pi \cdot \left(\frac{6.25}{2} \right)^2 \cdot \text{in}^2$$

$$Q := Cd \cdot Ao \cdot \sqrt{2 \cdot g \cdot (h1 - z)}$$

$$Q = 120.135 \text{ cfm}$$

$$Q = 2.002 \frac{\text{ft}^3}{\text{s}}$$

Pipe ID

$ID := 7.9 \cdot \text{in}$ $hi := 31.74 \cdot \text{in}$ $z_w := 19.74 \cdot \text{in}$

$$Ao_w := \pi \cdot \left(\frac{7.9}{2} \right)^2 \cdot \text{in}^2$$

Type 5 Flow

$$Q_w := Cd \cdot Ao_w \cdot \sqrt{2 \cdot g \cdot (h1 - z)}$$

$$Q = 144.545 \text{ cfm}$$

$$Q = 2.409 \frac{\text{ft}^3}{\text{s}}$$

Conclusion: An 8" sch 40 IPS pipe will support the required drainage from ESC-6. This 8" pipe will tee into the 10" culvert that drains ESC-7.



ESC - 7 Sufco Mine Drainage Culvert

Reference: Lindeburg, Michael PE; Civil Engineering Reference Manual 8th Edition

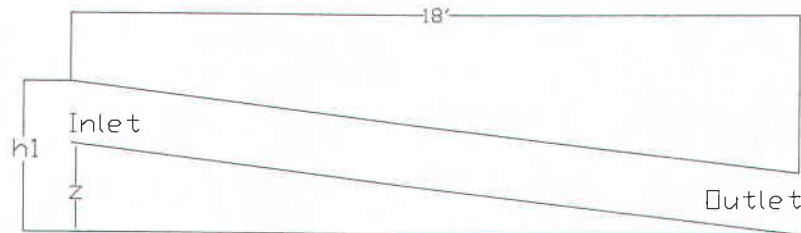
Pipe ID

$$D := 6.25 \cdot \text{in}$$

$$h1 := 44.75 \cdot \text{in}$$

$$z := 26.5 \cdot \text{in}$$

$$h4 := 5 \cdot \text{in}$$



Assume water column one foot above the inlet

$$\frac{h1 - z}{D} = 2.92$$

$$2.92 > 1.5$$

$$\frac{h4}{D} = 0.8$$

$$0.8 < 1.0$$

Type 5 Flow (p19-27)

$$Cd := 0.95 \quad Ao := \pi \cdot \left(\frac{6.25}{2} \right)^2 \cdot \text{in}^2$$

$$Q := Cd \cdot Ao \cdot \sqrt{2 \cdot g \cdot (h1 - z)}$$

$$Q = 120.135 \text{ cfm}$$

$$Q = 2.002 \frac{\text{ft}^3}{\text{s}}$$



Pipe ID

$$ID := 7.9 \cdot \text{in} \quad hi := 44.75 \cdot \text{in} \quad z := 26.5 \cdot \text{in}$$

$$Ao := \pi \cdot \left(\frac{7.9}{2} \right)^2 \cdot \text{in}^2$$

Type 5 Flow

$$Q := Cd \cdot Ao \cdot \sqrt{2 \cdot g \cdot (h1 - z)}$$

$$Q = 191.94 \text{ cfm}$$

$$Q = 3.199 \frac{\text{ft}^3}{\text{s}}$$

Conclusion: An 8" sch 40 IPS pipe will support the required drainage from ESC-6 and ESC-7, however a 10" pipe should be placed to account for possible future changes.